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UNITED STATES DEPARTMENT OF AGRICULTURE
Research Program Development and Evaluation Staff
Washington, D. C. 20250

REPORT AND RECOMMENDATIONS
of the
HORTICULTURAL CROPS RESEARCH ADVISORY COMMITTEE
Developed at its Meeting
February 14-18, 1966
Washington, D. C.

HORTICULTURAL CROPS RESEARCH ADVISORY COMMITTEE

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PREFACE

The third meeting of the Horticultural Crops Research Advisory Committee was held in Washington, D. C., on February 14-18, 1966, with 16 of the 17 members present. Dr. Oyler was unable to attend. Mr. John T. Lesley, Florida Citrus Exchange, Tampa, Florida, attended as a representative of the National Agricultural Research Advisory Committee. Mr. Earl R. Glover, Acting Deputy Administrator for Marketing Research, Agricultural Research Service, acted as Chairman.

The Committee made a systematic review of the Department's research program on horticultural crops as contained in the December 1, 1965, progress report on Horticultural Crops. This was supplemented by a presentation of administrative and budgetary developments; a tour of selected laboratories of the Agricultural Research Center, Beltsville, Maryland; and discussions by USDA staff members of current and projected programs of Farm Research, Nutrition, Consumer and Industrial Use Research, and Marketing and Economic Research.

The Committee also considered written statements of research needs submitted by the American Phytopathological Society.

After careful review of the information available, and based upon current and future need for new knowledge and the seriousness of problems faced by the industry, the Committee made the following comments and recommendations.

I. GENERAL COMMENTS AND RECOMMENDATIONS

Increased Support for Agricultural Research. The research methods and organization of the United States Department of Agriculture are unique. There is no comparable system anywhere else in the world. The results of this research have made it possible for our agriculture to feed and clothe millions of people in other lands. However, famine stalks India, many African nations and in other areas of the world. Our food surpluses are less and less a problem. Every bit of sound research we can muster will be necessary to feed and clothe our own people and the deficient areas throughout the world. Scientific personnel and procedures are not short-range tools. The effectiveness of results in 5, 10, 20 years are being determined now by the training of students and scientists. Projects initiated in 1966 will determine the excellence of the results in the years ahead. It would be disastrous to reduce the financial or personnel support of the research and development work of the United States Department of Agriculture. It becomes more and more evident that there is a race between the population explosion and food production. No government has the capacity to meet this challenge as our government. We need to increase our support of the research and development work of the United States Department of Agriculture now.

It is difficult to reason for democracy with parents whose children are hungry.

To achieve the objectives to which our nation aspires, it will require the finest talents, the best brains, the most dedicated scientists we can train. In this time of increasing need we must do everything we can to encourage and train men and women to develop careers in research.

Breakthroughs by the USDA in research and development have advanced medicine, health, recreation, science, industry and every phase of our social and economic life. Because of these achievements by dedicated personnel we are able to wage peace as well as war. We believe it vital that increased support be given rather than reducing appropriations. Without the excellent record of performance, the fantastic programs in space, technology, Peace Corps, and War on Poverty would not be possible.

Agricultural research is indeed as much a front line of our defense as our Army, Navy, or Air Force. It requires a much smaller budget. We urge these important facts be called to the attention of the Members of Congress, the Secretary of Agriculture, and the President of the United States.

Modernization of Beltsville Facilities. The far-reaching benefits provided by the basic research work being carried on at the Agricultural Research Center, Beltsville, Maryland, make it essential and economically practical to provide more adequate and modern facilities.

The Committee observed on its tour through several laboratories and greenhouses at the Research Center that the scientists were seriously hampered by inadequate facilities and overcrowding. The horticultural sections of the greenhouses in particular need modernization, and the laboratory areas should be considerably expanded.

Due to increased demands for research on horticultural crops, and recognizing fully the very important work being done at Beltsville, this Committee would recommend an immediate survey be made of critical needs, and requests a non-recurring appropriation be made to bring this important installation up to date.

Research Facilities for Human Nutrition. Last year this Committee noted that more adequate facilities for human nutrition research were needed if the Department is to implement the recommended expansion of consumer-oriented food and nutrition research. We regret that the current budget again does not include funds for a central research facility for human nutrition studies. Our Committee and others have long considered that this construction should have high priority. We again urge the Department to support the funding of a headquarter facility adequate to its important mission of researching the nutrient and food needs of healthy individuals.

Research and Training in Plant Bacteriology. The Committee urgently recommends the establishment of a pioneering research laboratory or other mission-oriented research group for phytobacteriology in order that a sound basic research program can be initiated on bacterial pathogens and the diseases they cause. It also recommends increased support for mission-oriented research and for training of plant pathologists at the graduate level in this field. At present in the United States there are fewer than 20 scientists concerned on a full-time basis in this important field. At the same time, there has become a very urgent need for increased research on bacterial diseases in the United States.

Restrictive Personnel Ceilings. This Committee strongly urges the removal of present policy of restrictive personnel ceilings. This policy discourages qualified people who might consider a career in the Department. In addition, the policy hampers vital work and dilutes total effort.

Reduction of Hatch Funds. This Committee views with great alarm the reduction of Hatch Funds to land grant colleges as projected in the fiscal year 1967 budget. We recommend that these funds be restored in full.

Restrictions on Travel. The Committee is very concerned about the restrictions placed upon travel of personnel assigned to all types of agricultural research and development. Undoubtedly much field work and intra-laboratory travel is necessary to initiate and evaluate the laboratory theories and findings. Many times the field and on-the-job work is the locale of the research. Restrictions placed upon travel have tended to limit and discourage excellence of work, depth of research and continuity of personnel. We seriously believe the economies achieved in these travel restrictions are minimal in dollars. The reductions in desired scientific results are of great concern to this Committee.

Coordination of USDA and Private Research. The agricultural research potential of various phases of private industry has grown to tremendous proportions. There is undoubtedly an opportunity for the Department to interest outside efforts on our horticultural problems through the dissemination of statements of need or otherwise providing more effective liaison.

Many new chemical, mechanical, and biological developments may have horticultural possibilities unrealized because of lack of application.

Use of P.L. 480 Funds for Research. The Committee commends the Department for the current program of research in foreign countries, utilizing funds made available under Public Law 480. It recommends the continuation and expansion of studies of U.S. agricultural products in foreign markets with these resources. The Committee requests that a report of the results to date of all studies abroad relating to horticultural crops be prepared and submitted to the Committee prior to or at its next meeting.

Assistant Secretary for Science and Education. The Committee reaffirms its recommendation of last year that an Assistant Secretary of Agriculture for Science and Education be established. It wishes to commend the USDA for its attitudes and the general direction the Department is following to enhance agricultural research. The prestige of research on agricultural problems would be materially improved by the recognition accompanying an assistant secretaryship having responsibility in this area, the Committee believes.

Research Balance--Basic and Applied. During the past few years there has been a swing in emphasis from applied research to basic research. The need for basic research is fully recognized, but at all times a proper balance must be maintained between the two types. Basic phases should not be done at the expense of applied.

Cooperative Programs. The Committee wishes to commend the Agricultural Research Service for its improving cooperative programs with State Experiment Stations on research work best handled in an individual State. It is recommended that this policy be continued and expanded to allow the Agricultural Research Service to give more attention to (1) research which necessarily cuts across State and regional lines; and (2) coordination of research efforts by both USDA and State personnel.

Planning--Programming--Budgeting. We highly commend the recommendations by the Secretary of Agriculture in his Memorandum No. 1589 to develop a planning, programming and budgeting system for the Department of Agriculture. This plan will assure project validity prior to initiation and with a high degree of confidence, will guarantee continuity of project, will place checkpoints for evaluation and controls and will assure attainment of goals within realistic time schedules and budgeted funds.

Improved Mechanization Research. The ability to maintain an adequate food supply of high quality for the consumers of our nation has been hampered by the lack of competent farm labor. The critical farm labor supply problem, particularly as it pertains to harvesting labor, has created a most urgent demand for an expanded research program into the agricultural engineering techniques. We cannot overemphasize the need, and time is of the essence, for development of practical devices and systems starting with the seed bed, to plant, grow, harvest, transport, process, package, and deliver our horticultural crops on a quality basis. Mechanical harvesting demands precision planting. Precision planting demands a whole new look

into the development of new improved varieties of all horticultural crops. Accelerated research is recommended for new and better methods of harvesting and milling vegetable, field, and flower seed.

Effects of Air Pollutants on Yield and Quality of Horticultural Crops.

Cooperative university, USDA and industry research conducted by the Air Pollution Research Center of the University of California at Riverside has shown that industrial and auto exhaust air pollutants are producing serious crop damage in the Los Angeles Basin. For example, a large-scale field research effort by this Institution is now beginning to show quite clearly that yield of citrus is being drastically reduced by smog. Other examples of serious air pollution damage to crops, such as flecking of wrapper-tobacco, can also be cited in the eastern United States. Thus, air pollution is now recognized as a rapidly growing national problem with crop losses occurring particularly in the high-value, intensive farming areas close to centers in which industrialization and urbanization is expanding rapidly. The U. S. Department of Agriculture is urged to greatly expand its participation and support of research on air pollution damage to crops. If research on this problem is not prosecuted on a scale commensurate with its menace, it will ultimately seriously blight not only our food and fiber producing potential but our health and well-being as a nation.

Control of Insects. The outstanding research of practical and theoretical control of insects has been brilliant. Entomological and biological methods of control, often in conjunction with chemical procedures, have shown dramatic breakthroughs.

The growing demand for food in this country and abroad focuses the need for more effective means of producing higher quality, larger volume crops. This cannot be achieved without continuous and increased support. Adequate financing of these projects in the laboratory and in travel funds must be strengthened. Attempts to restrict travel related to this research is very expensive economy.

Urban Oriented Agriculture. The population explosion has created vast populated areas extending hundreds of miles and often referred to as the "megapolis." Within these and nearby areas are thousands of small agricultural units of varying sizes and capacities. The Committee believes that this "urban oriented agriculture" serves a real economic need and should be encouraged. To this end we recommend the United States Department of Agriculture should initiate research that would apply to "Urban Oriented Agriculture" as opposed to research that is more applicable to larger units producing many of our foods and fibers.

The "fresh market," quality oriented, giving more service than is possible in our mass distribution systems begins to take a significant place in the health and well-being of our people. This "Urban Oriented Agriculture" includes food, pleasure, and services such as fresh fruit and vegetables, decorative flowers and shrubs, green areas where animals and poultry can be observed and enjoyed, picnic areas where swimming, fishing, and pony rides are available. Nursery and landscaping services are part of this

new look. We urge the USDA's help to correlate the potential of this new agriculture so that it can take its rightful place as a strong arm of our nation.

II. COMMENTS AND RECOMMENDATIONS ON CURRENT PROGRAM AND NEEDED RESEARCH

In recommending new or expanded research on problems listed in this section, the Committee recognizes that it is not its responsibility to delineate between research to be conducted within the Department and that to be conducted in cooperation with State Agricultural Experiment Stations and other research organizations. The recommendations made by the Committee are based on their judgment that the problems are important and that research is needed by the Department on them. The Committee did not establish any priorities as to importance of problems recommended.

FARM RESEARCH

Virus Diseases of Horticultural Crops. Yields of most horticultural crops have increased strikingly in the past two decades, due largely to improved varieties, pest control methods, and cultural practices. It is now becoming increasingly clear that virus diseases are among the chief limitations to further improvement in yield and quality. So far, little progress has been made in devising methods of curing a virus disease, once the plant has become infested. Growers must rely largely on avoidance procedures. The Committee recommends that the U. S. Department of Agriculture greatly expand its research program on virus diseases of horticultural crops, giving emphasis to the nature and mechanism of virus disease damage to plants which, hopefully, would ultimately lead to chemical, biological or other means of curing infected plants. In addition, we recommend that the location and organization of such expanded efforts should be designed to afford maximum support of the graduate training of research specialists in this field.

The establishment of a pioneering laboratory or other specialized research group dedicated to basic research on the mechanism of virus disease damage would lead to the speediest answers.

Virus Disease of Citrus. Recent evidence makes it clear that "stubborn disease," long known to be a virus disease transmitted by vegetative inoculation, is several-fold more prevalent in plantings established in California and Arizona during the past six to eight years than in older bearing plantings. This alarming increase in stubborn disease in new plantings suggests that a vector is causing natural spread, or that the virus is becoming established in new rootstocks or grafts. If efficient methods of identification and control are not developed soon, very severe losses will occur. So far, no important variety or rootstock has shown any appreciable tolerance to the disease. Additional research on stubborn disease is needed to insure the rapid development of reliable means of identification and control or avoidance.

Recently, there has been a highly destructive outbreak of the tristeza virus disease of citrus in several orchards in the vicinity of Elfers, Florida. In one property of 1,000 trees on the susceptible sour orange rootstock, only 130 remain; the rest have been destroyed. Heretofore, tristeza has not been sufficiently virulent under Florida conditions to cause much concern, although it has been known to cause sporadic minor damage over the past 20 years. This recent outbreak is causing grave concern that either a new, more destructive strain of the virus, or a more efficient vector or spreading agent has been introduced to Florida. Since the tristeza virus wiped out all citrus on susceptible rootstock in several major citrus areas in California during the past 25 years, it is feared that this disease may now be embarking on a similar destructive rampage in Florida.

The Committee recommends that research on both stubborn and tristeza virus diseases of citrus be accelerated substantially to protect the future of the valuable citrus industry.

Virus-Free Ornamentals and Other Diseases. Ornamental plants play an ever increasing role in our affluent society. Development and maintenance of virus-free sources of parent stock is a greatest importance.

Potato tuber virus continues to plague the industry and needs intensified attention; so does the crown blight complex of melons.

Bacterial Diseases of Horticultural Crops. During the past several years, bacterial diseases of horticultural crops have become more prominent than ever with highly significant losses occurring in beans, cucumbers, peas, peppers, tomatoes, pears, apples, and other horticultural crops. Since there has been very little concerted effort on the control of bacterial diseases of horticultural crops, the Committee recommends a sound basic research program be initiated on bacterial diseases. Information is needed on distribution, detection, survival in the plant and in the soil, pathogenesis, ecology, transmission, and the control. Investigations on detection should include the use of serology, histo-chemistry, fluorescence microscopy, and bacteriophages. Control methods should include the use of cultural, chemical, and biological devices, including the use of bacteriophages and the development of disease resistant varieties. This research should be organized and located in a manner that will stimulate graduate training of research specialists in this field.

Bacterial Blight of Beans. Bacterial blight has become of major concern in all bean producing areas east of the Rocky Mountains. It has been especially severe in the bean producing areas of Wisconsin, Michigan, New York, Idaho, Oregon, and Nebraska. The infestations are not limited to one particular organism, but include the halo blight and common blight organisms as well. The specific organism causing halo blight has been present for the past several years in the bean producing areas of Idaho where most of the nation's snap and canning bean seed is produced. This infection has resulted in tremendous losses to farmer-growers and seed companies, as well as to canners and freezers in the areas where the beans are grown for processing.

As originated in 1965, continued efforts are needed to develop techniques for identifying and controlling the bacterial blight organisms in and on the seed and plant. It is suggested that this study be sufficiently broad in scope to encompass all aspects of the organisms so that similar methods of investigation may be applied to other harmful bacterial pathogens. It is further suggested that this study establish short- and long-range objectives; that short-range objectives include: (1) methods for elimination of seed infection; (2) methods for identifying the organisms in minute quantities; (3) methods of field control (soil, plants, insects); and (4) development of disease resistant varieties suitable for processing. The long-run investigations should include the necessary basic research to eliminate the organism.

Tree Fruit Diseases. A serious problem in the culture of peaches in the peach growing States has threatened the industry. The disease, referred to as "peach decline," may result from a combination of factors including inherent weaknesses, and physiological conditions. Special attention must be given to the situation to identify the cause and find ways to reduce losses from this disease before a real disaster occurs.

Perennial cankers caused by Cytospora-Valsa organisms and annual cankers caused by Fusicoccum organisms are causing serious concern in northeastern, central and western fruit orchards. Pruning wounds, particularly from early pruning, and wounds caused by shaking claws on harvest machines render trees quite susceptible to the disease. Since the disease often is associated and confused with winter injury, the problem has been an elusive one. The causal organisms have been known, from Idaho and New York studies, for over 20 years but little recent progress in control has been made. A preventive wound emulsion has been of some help in controlling the disease but is not a practical solution. If mechanical shaking is adopted for harvesting, this problem may become even more serious.

The Northwest Italian prune industry has suffered from an assortment of physiological disorders affecting the internal condition of the fruit. A breeding program is requested to eliminate these disorders while maintaining the high quality of this species.

Strawberry and Raspberry Diseases. Strawberry black root rot, which is a destructive disease that badly stunts or kills all varieties of strawberries, is widespread and appears to be worse on land cropped extensively with vegetables, grains, and some grasses. Land fumigated with methyl bromide appears to have relatively little black root rot. New basic work needs to be initiated to determine the etiology of this disease and to provide control measures by fungicides and cultural treatments.

Leaf diseases are causing severe damage on Rubus and strawberries (leaf spot, leaf scorch, leaf blight and mildew) and are limiting factors to production in some regions. New work is needed to find a chemical control for immediate use and to breed resistant varieties for the future.

A new root rot has appeared in the northwestern United States that is killing most varieties of red raspberries, but tolerance is present in raspberries

so that tolerant varieties can be originated by breeding. The problem is complex and will require an extensive breeding program to solve.

Need for Thornless Blackberries. Preliminary breeding work has demonstrated that new thornless blackberries can be originated that will reduce cost of production. In Oregon and Washington the thornless Oregon Evergreen is now the most important variety in production and is of importance because of its thornless condition combined with high production. Earlier maturing, high quality varieties are needed. The cost of labor to grow the present thorny, earlier maturing varieties is becoming prohibitive and the acreage is declining. This reduces the income of farmers in the area and eliminates a very nutritious and delicious fruit from people's diet.

Potato Diseases. An expanded research program is recommended on the new races or strains of the potato scab pathogen. These new races pose a real threat to the potato industry in all potato producing sections of the East. Research to develop resistant varieties should be started immediately.

A continued and expanded research program is recommended on the Verticillium wilt disease of potatoes, as strains become more resistant to controls by long rotations. More research is needed on seed treatments, breeding of resistant varieties, and on biological and systemic control. Basic information on the development and control of this serious disease is especially needed.

Present work on the development of varieties resistant to the pathogens causing early and late blight of potato should be accelerated.

Disease Resistance in Vegetables. We recommend that immediate attention be given to:

1. The development of Fusarium root rot resistant asparagus varieties;
2. The development of bean varieties resistant to the many bacterial blight pathogens;
3. An expansion of the present research program on the development of white-seeded baby lima bean varieties resistant to mildew and to initiate a search for resistance to the pathogen causing stem anthracnose in lima bean. Stem anthracnose is becoming very widespread in lima bean areas, especially in the South;
4. An acceleration of investigations toward the development of lettuce varieties resistant to lettuce virus and adaptable to machine harvest. We recommend the use of cytoplasmic male sterility for hybridization be made a part of this study;
5. The continuation of research on the development of disease resistant carrot plant materials;

6. The development of multiple disease-resistant tomato and cantaloupe varieties that are adaptable to mechanical harvesting.

Hardiness in Ornamentals. Approval and encouragement should be given to the breeding and selection of woody ornamentals at Cheyenne, Wyoming, to obtain more desirable cold-hardy and dwarf type plants for home and roadside plantings and to the development of new varieties of carnations, roses, and lilies.

The Committee also recommends a sound basic research program to determine the nature of cold hardiness in ornamental plants. Plant losses due to lack of winter hardiness plague both the general public and the producer.

Salt-Water, Cold-Hardy, or Smog-Resistant Plants. The need for expanded, coordinated investigation into the effects of air and water pollutants on plants is becoming increasingly urgent.

There is a definite need for salt-water tolerant, cold-hardy ornamental palms for our coastal areas. There is also a need to develop plants for the small home, for highway and street beautification, and for ground cover that incorporate smog and salt-water tolerance.

Late Blooming Almonds to Escape Frost Damage. Almonds are subject to serious losses because they bloom early and blossoms are often killed by spring frosts. There is urgent need for an expanded program to breed commercially acceptable late-blooming almonds that escape spring frosts and, thus, produce consistent year-to-year crops.

Nematode Control. Crop yields have been substantially increased by improved varieties and cultural methods, but damage to root systems by a wide variety of nematode parasites is becoming a limiting factor to further increases in yields. We again strongly urge that additional research funds be made available to investigate and expand present investigations on the control and eradication of nematodes and that these investigations include all the possible methods including the use of chemical, biological, physical, physiological, genetic, and other methods of control, including chemo-sterilants. Methods should be developed for suppressing nematode damage and for determining the interrelationships with other organisms, such as viruses and fungi. In addition to the crops presently under study, we would recommend that grapes, citrus, sugar beets, cabbage and related crops, potatoes, onions, garlic, flowers, ornamentals, and shade trees be included in the investigations. There is definite need for expanded studies on the biology of nematodes with special emphasis on classification, physiology, reproduction, the mechanism of pathogenic action in plants, and the nature of resistance and tolerance of plants to nematode damage. The increased emphasis on interstate quarantines requires that additional research on the control of these organisms in the soil and on the roots of plants is absolutely necessary. For ornamentals, treatment after removal from the soil is necessary for interstate movement of plants.

Our final recommendation on nematode control is that much of the research be organized and located in such a manner as to stimulate graduate training of research specialists in this field.

Weed Control. Acute labor shortages, chemical residue problems and foreign competition make it urgent that research in weed control of all horticultural crops be pushed very hard. The Committee urgently recommends a many pronged attack including research on the use of herbicides, biological control, and other methods to control weeds in order to reduce the cost of production. Season long herbicides adaptable to precision planting and mechanical applications are needed.

Growth Regulators. The potential of growth-regulating chemicals is very important to the future of the horticultural crops industries. These regulators must be more thoroughly investigated as to both short- and long-term effects on fruits, vegetables, ornamentals, and soil. A basic understanding of how and why they affect growth is vital to their full utilization by industry. Other reactions and uses should be investigated, including chemically induced winter hardiness and disease resistance, delayed blooming in the spring, flower-bud development and increased and decreased growth rates.

New growth regulators offer ways to increase yields and improve quality. Information is needed to learn the effect of gibberellic acid on the growth and flower formation of strawberry plants. Also, to learn the effect of known chemical growth regulators such as CCC, phosphone, maleic hydrazide, and B-9 to increase flower formation and induce precocious fruiting of blueberries and grapes. Other new chemicals should be tested to see whether any will cause uniform ripening of berries within the clusters of strawberries and blueberries to reduce cost of harvest. No work of this nature is being done by USDA. Also, work is needed to determine new methods of propagation that will give rapid increase of disease-free plants. Studies should be conducted with low temperatures to learn what factors are important in the winter hardiness of plants.

Tree Fruit Rootstocks. All commercial tree fruit varieties are vegetatively propagated and all are propagated on some kind of a rootstock. Since rootstocks are known to significantly affect the size, age of bearing, and production of scion varieties of the pome fruits, a study should be made of these effects of various rootstock-scion combinations as related to genetic and physiological differences between rootstock and scion.

Citrus Physiology. The physiology of citrus is influenced by many factors including climate, nutrition, rootstocks, and diseases. The physiology of citrus on the other hand can be changed so as to influence to a degree the resistance to cold hardiness, improved fruit quality, and other features. New growth-retarding and dormancy-producing chemicals are now available but little is known of their effects on citrus. Basic physiological studies to determine more specifically the relationship of growth to fruit quality, cold hardiness, and disease resistance needs to be initiated.

Physiological Research on Potato Quality. With the introduction of many new potato varieties and with rapid changes in production and handling methods, new and unsolved problems have developed resulting in unsatisfactory quality of potatoes for fresh and processing uses. Physiological research should be initiated on the keeping and eating quality of the product for specific uses

with special emphasis at the national level on black spot, stem-end discoloration, and after-cooking blackening and production factors that condition potato quality.

Polyembryony in Citrus. Because of the phenomenon of polyembryony, citrus breeding has been limited quite seriously in the selection of maternal parents. As an example, little breeding for the improvement of orange varieties through hybridization has been possible. We recommend that basic research be undertaken to study the mechanism of this phenomenon and devise possible means of penetrating this barrier.

Onion and Carrot Seed Production. The Committee recognizes that low yields of onion and carrot seed in the western states make it uneconomical to produce in that area. It recommends research be directed to determine the cause for the low onion and carrot seed yields in Idaho and California especially, and that steps be taken towards improvement in yields.

Hybrid Onions. The contributions by the U. S. Department of Agriculture to the development of hybrid onions cannot be overemphasized. It is recommended that inbred onions developed for hybrid onion production be released as soon as possible after the inbreds are developed. There is a need for slow bolting, high solid processing and marketing onion varieties and hybrids. Funds presently being spent for hybrid onion development should be redirected into a study on the mechanism involved in cytoplasmic male sterility.

Lettuce Harvester. Work should be expanded in cooperation with the University of California and the University of Arizona to improve the lettuce harvester, of which there is a prototype. Particular attention should be given to the method of orienting cut heads and the method of trimming following orientation. A suggested electronic device should be developed to scan leafy vegetables for both surface and internal defects such as tip burn, decay, and/or mold. Better means of handling raw products, particularly broccoli and cauliflower, should be researched.

Potato Harvesters. Most research on potato harvesting has been, and is continuing, on machines adapted to stone-free soils. There has been an urgent need to develop a mechanical harvester for stony and cloddy soils in the old established areas that have been in potato production for many years. These areas have production and marketing advantages, but with the unavailability of hand labor, as was so dramatically demonstrated by the labor shortage in the 1965 harvest season, these producers will have to greatly curtail production unless a harvester is developed for their particularly unusual soil conditions. This Committee recommends the implementation of the \$240,000 cooperative research program proposed by New York and Maine Experiment Stations on a cost-sharing basis, with USDA contributing \$120,000, New York \$60,000, and Maine \$60,000. We urge the acceptance of this cooperative program.

Tree Fruit Harvester for Large Trees. The results obtained from application of research developments on tree fruits is impressive on the few varieties adaptable to mass-removal techniques. Many varieties, both deciduous and citrus, do not lend themselves to shake and catch harvesting without devastating effects on fruit quality. It is imperative that research be continued and expanded on mechanizing the harvest of all fruit crops, including all tree sizes and types and intended uses of the product. While the trend in new tree fruit plantings and techniques is toward hedge rows and tree walls

which are more easily harvested, the vast majority of production is from large, individual trees. The harvesting of these larger units must be mechanized, both for processing and fresh fruit utilization.

Orchard Heaters. There should be intensified research involving the protection of tree fruit from frost damage. The introduction of smaller-than-standard trees to ease harvesting problems creates complications in frost prevention, and will require a thorough investigation of orchard heating techniques, equipment, and solid recommendations to the industry.

Beneficial Insects. Insects friendly to agriculture have become inadvertent victims of our times. This is true especially of the wild insects that aid pollination. We urge studies to develop methods of increasing helpful wild insects, such as the bumblebee, so that crops suffering from a lack of adequate pollination may increase their contribution to a strong agriculture. It is recognized that this is a segment of a larger problem involving research on manipulation, use, and conservation of beneficial insects as a natural resource.

NUTRITION, CONSUMER AND INDUSTRIAL USE RESEARCH

Staff and Facilities. We most urgently recommend the provision of adequate staff and equipment for all utilization research laboratory space now existent, or for which construction has already been funded, to make certain that such laboratories will be effectively and efficiently used to carry forward the important and needed research to build new markets for horticultural crops. In particular, we refer to space at Winter Haven, Florida, and Weslaco, Texas, to be available during the next fiscal year.

Chemical and Physical Properties. To provide a basis for the development of new and improved processed products and the improvement of processing technology, a more detailed knowledge of the chemical composition of fruits, vegetables, and tree nuts is essential. Research should be expanded on major and minor components, the structure and properties, and changes that occur during processing of these crops. Immediate emphasis is needed on:

1. Chemicals in fruits and vegetables involved in flavor, color, aroma, texture, and nutritive value;
2. Factors that may affect the health of people in a desirable way;
3. The nature of the chemical changes that take place as a result of processing;
4. The study of enzymes in fruits and vegetables and how they change color, texture, and other quality factors;
5. The way compounds change during processing of fruits and vegetables that affect stability of processed products.

New and Improved Food Products. A continuing adequate supply of fruits and vegetables depends more and more on preserving them and making new and improved products. Dehydrated products of low volume and weight offer

relief from mounting distributing costs. Domestic consumers demand variety, novelty, convenience, and minimum cost. Export markets, particularly for concentrated and dehydrated products that are inexpensive to ship, can be developed in countries where economic conditions are improving. Tree census, showing huge acreages of still nonbearing fruit, indicates a future increase in fruit production beyond population growth and emphasizes the need for products that can compete in international trade. We recommend expansion of research to develop new and improved products. Examples are research that will:

1. Develop commercial use of experimental products (e.g., foam-mat-dried citrus and other fruit juices, sugar-osmosis-dried fruits, drum-dried instant applesauce and other fruit flakes, dried fruit chips for use in breakfast cereals, explosion puff-dried vegetables, precooked dry bean powder, chilled peach slices and juice products, etc.);
2. Develop new and improved products from horticultural crops (e.g., products from subtropical regions to diversify production in Hawaii and Puerto Rico, concentrates of fruit flavor to add back to preserved products, frozen fruits and vegetables that retain fresh product textural qualities, traditional potato products that are rebuilt from potato flour and other dried potato products, new products that retain the fresh flavor of chilled citrus juices for longer distribution periods, tomato products with controlled consistency for different uses, etc.); and
3. Use more effectively the processing grade fruits and vegetables (e.g., under- or over-mature fruits and vegetables resulting from use of mechanical harvesting equipment, misshapen, blemished, and under- or over-sized materials, etc.).

Market Testing New Products. Research should be expanded to determine market possibilities and economic feasibility of new consumer products developed by the Utilization Research and Development Division laboratories in order to advance them into commercialization.

Improved Processing Methods and Equipment. Food processing methods must be continuously evaluated to reduce costs and improve quality. Both basic and applied research should be expanded and directed towards such innovations as:

1. Saving costs by finding methods of decreasing temperatures needed to destroy spores of food spoilage organisms;
2. Methods of improving color, texture, and convenience of serving frozen, dried, and concentrated products (e.g., strawberries, juice powders, celery and green beans, etc.);
3. Finding means of making uniform high-quality products from variable raw material;
4. The development of means for processing fruits and vegetables so that waste liquid discharge from plants is of such a nature that it causes a minimum of contamination in lakes, rivers, or other bodies of water

5. Developing new ways of drying and concentrating, such as explosion puff-drying and drying by osmosis;
6. Developing new methods of preservation of fruit and vegetables by pure-culture fermentations whereby the chance of loss by uncontrolled fermentation is decreased and quality is improved; and
7. Developing means of controlling quality during processing operations.

Additional research is needed specifically on decreasing the bitterness of grapefruit and navel orange products, improving the stability of dehydrated and frozen fruits and shelled nuts, reducing the amount of additives required in dried fruits so they can be exported, improving the retention of fresh flavor and texture in potato products, and improving the texture and color of vegetables preserved by fermentation, especially cucumber pickles.

Characterization and Control of Raw Material Quality for Processing. New varieties and the effectiveness of new growing methods must be evaluated as to quality of preserved fruits and vegetables. Such would include:

1. New citrus varieties selected for resistance to freeze damage;
2. New berries with improved disease resistance;
3. Varieties of fruits and vegetables that can be mechanically harvested;
4. New citrus varieties with desirable flavors;
5. Growing and fertilizing methods that increase yields;
6. New peach varieties for the southern coastal states that can assure an adequate supply of material for processing every year, etc.

We recommend that cooperative research be expanded by utilization research scientists with plant breeders, agronomists, engineers, and others who develop new varieties, harvesting equipment, and improved growing practices to evaluate processing quality before new varieties are released or new growing or harvesting methods are extended to commercial farming. This type of work should be done at or near field locations so that materials used for processing studies will be equivalent to raw material used for commercial processing.

Prevention of Microbial Deterioration. Processed fruits and vegetables are sometimes spoiled by microbial contaminants prior to and during processing and in channels of trade. The possible hazards related to new products and processing methods by such spoilage can be harmful to consumers and to the entire processing industry. Research to prevent microbial spoilage

should be expanded to develop procedures for improving the safety and quality of products. New research should be initiated to learn how dangerous microbial contamination is and to develop means to control it.

Waste Disposal. Disposal of processing plant wastes is a problem of agriculture, and we recommend the initiation of a research program in the Department of Agriculture with the objective of developing satisfactory techniques to solve the specific problems of the food processing industry.

Interagency Working Relationships for Nutritional Research. With nutrition programs assuming an increasingly important role in various government departments having different missions, the problem of communication and coordination needs continual attention. It is important that the competencies and contributions of existing nutrition programs be fully utilized, that duplication of research efforts be avoided, and also that major gaps in nutrition research do not result from too narrow interpretation of agency responsibilities. It is recommended that the program administrator and the research scientists of the Department continue to seek and maintain close working relationships with all government agencies developing or using nutrition information. This will help assure both the full use of the research findings in action programs and the most effective placement of the limited funds available for nutrition research.

Role of Carbohydrates in Fat Metabolism. Our Committee feels that high priority and support should continue to be given to basic nutrition research which can further our understanding of the role of different carbohydrates in fat metabolism. Quite different nutritional responses have been reported for the simple sugars such as are found in fruits, and also between these sugars and starches. There is too little information concerning the dietary responses to combinations and amounts of different carbohydrates as they occur in foods. We urge expansion of such fundamental studies using human subjects as well as experimental animals. The findings may well have important implications for horticultural crops which provide a variety of carbohydrates in the diet.

Nutrient Analysis of Fruits and Vegetables. We are pleased to learn of the progress being made in methodology and in uncovering and assembling new information on the nutrient contributions of various foods. A continuing and vigorous program of food analysis for nutrients and the forms in which they occur is important in providing needed information to growers, to industry, and to the consumer. This research should be extended to include analysis for specific carbohydrates, trace minerals, and various lipid and fat soluble vitamin components of fruits and vegetables which recent research has shown to be nutritionally important and for which only limited data are available.

Food Products Used in Homes and Institutions. In a consumer-oriented program the Department also needs a strong program of research to keep abreast of existing and new food products and processes and to develop recommendations for their use under the variety of conditions existing in homes and institutions in order to insure satisfaction and continued use by consumers. About \$20 billion is spent annually on meals eaten away

from home, contributing largely to the food habits and nutrient intake of all segments of the population from preschool children to senior citizens. Research should be initiated on the most critical problems for fruits and vegetables including the protection of flavor, texture, color, nutritive value, and microbial safety during preparation and serving in restaurants and centralized food services.

Updating and Expansion of Nutritional Information in Agricultural Handbook 8. The Committee recommends that review of research findings on the composition and nutritive value of food be continued as required for keeping the basis of Agriculture Handbook No. 8 up to date. The scope of this compilation should be expanded to include new food products and additional nutrients important for keeping abreast of developments in nutritional knowledge. The Committee is pleased to know that data are being summarized for trace elements and three important B-vitamins and recommends that as soon as time and funds are available, data for other nutrients, especially amino acids, fatty acids, and vitamin E be compiled.

The Committee recommends that in addition to the technical publications on the nutritive value of foods, the information be adapted for direct use by individuals and by organizations working on food and dietary problems.

Compilation and Interpretation of Food and Nutrition Research Data. The Committee considers that research-based guidance materials for use in problems of selection, use, and care of food is of vital importance to the general health and well-being of our population. Compilation and interpretation of the findings of food and nutrition research should be continued to provide a sound basis for these materials and efforts for getting this information to the public should be intensified.

Release of Findings in 1965 Food Consumption Survey. The Committee recognizes that the 1965 Nationwide Food Consumption Survey will provide a wealth of data with valuable implications for agriculture, food industries, and consumer services. The Committee recommends that sufficient resources be made available to expedite the release of the basic findings as early as possible.

These should be followed by a series of commodity oriented summaries with the household data adapted specifically for use in consumer education programs and in marketing research concerned with the production, utilization and distribution of agricultural products. The data on diets of individuals should be further investigated to provide any information that could be useful in understanding food habits better, such as menu and time patterns in eating.

Need for Five-Year Periodic Surveys. The basic findings from the surveys are urgently needed as it has been too long, 10 years, since the last survey was made. With a rapidly improving situation in relation to food supplies and family incomes, even the six- or seven-year intervals between previous surveys failed to keep food consumption data up to date. Periodic, five-year nationwide surveys of food consumption are recommended.

MARKETING AND ECONOMIC RESEARCH

The Committee endorses the USDA research progress and plans as presented and discussed at the meeting and urges consideration of the following additional specific projects:

Packaging Fruits and Vegetables. There is a need for continued research in the field of packaging for most horticultural crops. While some work is in progress, more research is urgently needed for other fruit and vegetable crops.

Foreign Market Laboratory. Export outlets for fruits and vegetables are essential to the expanding U. S. industry. While apple and certain citrus fruit markets are well established, there is increasing European interest in fresh peaches, plums, grapes, sweet cherries, carrots, celery, head lettuce and dry onions from this country. The condition of these commodities in the European market will largely determine the development of this outlet. The Committee recommends the establishment of a market laboratory in Rotterdam or Hamburg for intensive evaluation of all American-grown fruits and vegetables as they move through wholesale and retail markets, for developing improved handling methods at overseas markets and for receiving and evaluating test shipments by U. S. research workers.

Mexican Import Situation. The Committee urges that research be initiated to evaluate the Mexican fruit and vegetable production and marketing potential including the possible impact of additional imports on producers, shippers, processors, and marketing firms.

Effects of Mechanical Harvesting on Market Quality. A critical factor in use of mechanical harvesters on vegetables is the development of postharvest decay and effects on the shelf-life of the product in the fresh market. Research should be initiated to evaluate the effect of available mechanized harvesting equipment on product quality, to reduce adverse effects on the commodity, and to develop methods for reducing postharvest decay in such products.

Mechanized Color Separation of Oranges and Grapefruit for Degreening. Early in the harvest season the color of oranges and grapefruit varies from light green to orange or yellow and degreening is based on the greenest fruit in the lot. Much of the fruit is exposed to the degreening longer than necessary. Research should be started on the development of an automatic color sorting machine for use before degreening so that fruit can be treated on the basis of degreening requirement. This will result in less favorable environments for decay and degreening rooms can be used more efficiently.

Effects of Seasonal Factors on Maturity and Storage Quality of Apples and Pears. Factors such as bloom date, temperatures at critical periods of crop growth, amount of sunlight and perhaps chemical spray materials appear to affect the harvest maturity, market quality, and storage life of apples and pears. Research should be expanded for an intensive study of seasonal factors influencing fruit quality and of the possible role of growth regulating chemicals in modifying postharvest fruit quality.

Vitality of Fresh Horticultural Products. Producers, distributors, and customers know that the storage period and shelf-life of fruits, vegetables and cut flowers may vary from season to season, between regions and among producers. Climatic, cultural, or other preharvest factors including variety may have a strong influence on the rate of aging or senescence of the product once it is harvested. The Committee urges the Department to accelerate its basic research on the nature and mechanisms of senescence of harvested plant products. Its scope should encompass histological and biophysical approaches as well as biochemical and physiological aspects. Hopefully, a greater insight into the aging process would provide tools to slow down this process by the application of improved cultural practices or by new chemical, physical or other approaches. Also, such research may ultimately provide simple objective tests for predicting shelf or storage life and/or susceptibility to invasion by fungi and other organisms.

Export Studies With Fruits and Vegetables. Research should be initiated in cooperation with the Transportation and Facilities Research Division to explore and develop improved handling methods and to provide optimum transit environments for maximum protection of quality of fruits and vegetables as a means of expanding markets.

Control of Insects That Attack Dried Fruits and Tree Nuts. More research is needed on the development of better, safer insecticides, fumigants, and application methods so minimum amounts of treatments will be required and pesticide residues will be avoided. Basic research should be conducted on the biology, ecology, and behavior of insects under the environmental conditions in which they attack dried fruits and tree nuts. Information from such research is needed as a foundation for developing new and more effective approaches to the prevention and control of insect infestation.

Bulk Transport of Potatoes. Huge quantities of potatoes now move directly from field or storage to processors or repackers who distribute consumer packages to retailers. Bulk movement of this part of the crops appears advantageous when equipment and methods of handling are available. Research should be resumed to evaluate bulk handling of tubers by rail and truck from the standpoint of physical damage to the tubers, protection from heat and cold, and wastage from decay and physiological disorders.

Controlled Atmosphere Storage for Propagating Material. Some evidence exists that the survival rate, growth rate and flowering period of certain bulbs, tubers, corms, cuttings, and roots are affected by composition of the atmosphere in which they are stored. Research should be expanded to determine the effects of storage in different partial pressures of oxygen, nitrogen, and carbon dioxide at several temperatures and to compare responses with comparable material stored in air.

Potato Chip Color Standards. In order to have a more satisfactory working relationship between potato growers and potato chippers, there is a need for a simple, inexpensive instrument and method for objectively measuring and identifying the color of chips so that such a color determination may someday become a part of the USDA grades and standards.

We recommend new research to develop: (1) a simple, inexpensive instrument to measure color of potato chips; (2) a chip color chart showing gradation in color from light to dark, to go along with the measuring instrument, in order to show the relationship between numbers from the instrument and the corresponding colors on a chart.

Marketing of Horticultural Specialty Crops. The Committee reaffirms its comments and recommendations of the past two years that the Department strengthen its economic and marketing research with appropriated funds on a continuing basis. The growing volume and the unknown potential for marketing flowering, foliage, ornamental, nursery products and bulbs through mass markets points up the need for more specific research in the areas of packaging, storing, transporting, and supply sources.

Improved Methods, Equipment and Facilities for Handling, Storage and Packing Fresh and Processed Foods. The intensification of the problems in the processing plant and the fresh fruit packinghouse as a result of mechanical harvesting "soft" fruits requires immediate attention. Research is needed on operations in the packinghouses and on methods, equipment, and facilities used at processing plants in connection with handling, conditioning, and storage of the commodities before and after processing. Since California is the largest producer of soft fruits, it is recommended that this research be initiated at Fresno, California.

Air Transport. Recent improvements in air transport have increased the opportunities to expand its use in marketing a number of agricultural perishables. These improvements include larger and faster planes with lower operating costs, containerization and improved cargo handling methods. The speed of air transport and improved handling techniques should provide savings in packaging, handling and refrigeration costs and reduce product and quality losses. Research should be undertaken to find ways to use this new technology to do a better job of transporting perishable farm products.

Improved Coordination of Transport Services. Costs and efficiency in marketing agricultural and food products depend to a very large extent upon how effectively the transport requirements of the physical distribution system are met. Poor coordination of the services of the different transport modes lowers the utilization rates for equipment and facilities, increases transport costs, and delays marketing and processing schedules. Operations research techniques afford the means of determining the most efficient means of coordinating the services of the different transport modes to meet the needs of the marketing system. Research to find ways to improve coordination of transport services for agricultural products and farm supplies should be undertaken.

Improved Methods of Packaging Agricultural Products for Food Purchase Programs by the USDA. At the present time the USDA purchases substantial quantities of food for direct donation, school lunch programs, Food for Peace, etc. Commercial packages and packaging materials are generally specified for the products purchased under these programs. Adequate consideration is not given to whether the product is underpackaged or

overpackaged. Research should be undertaken to determine the packaging needs for products purchased under current and future USDA programs and to set up standards which can be used by commodity inspectors.

Integrated Production, Marketing, and Pooling. Research information is needed on the integration of production and marketing by citrus cooperatives in Florida including an analysis of the effect of decision-making and grower returns; also on cooperative pooling practices and experience in marketing fruits and vegetables and to determine their effect on equity among members and efficiency in marketing.

Changes in Structure and Practices of Assembly Markets for Fresh Fruits and Vegetables. The advent of direct buying by large integrated retail food firms has substantially altered both the functions and importance of the marketing agencies engaged in the distribution of fresh fruits and vegetables. This has also had an impact upon the assembly phase in marketing fruits and vegetables. Research is needed to determine the nature of changes in the structure and practices of these markets to allow an evaluation of the extent to which they presently contribute to an efficient marketing system. This information will assist in efforts to establish a more efficient marketing system for fresh fruits and vegetables.

Future Demand for Florists and Nursery Crops. Economic research should be initiated to estimate the future demand for floral and nursery crops. Such information and analyses are needed for long-range planning to enable producers to more adequately meet the changes in demand resulting in part from the "beautify America" program. Particular attention should be given to estimating demand based on statistical series such as population, income, housing starts and other economic factors.

Crop Reporting. The Committee reiterates its recommendations that it is of utmost importance that crop reporting for major floral crops be continued and expanded from 11 to 26 States so as to provide information on over 90 percent of the production of the five major floral crops--roses, gladioli, carnations, pompoms and standard chrysanthemums.

Supply-Demand Information on Tree Fruits and Vegetables. To aid the citrus and noncitrus fruit industries in coping with the problems resulting from increased production, and to provide more orderly handling of their crops, information is needed on supplies, stocks, demand and utilization in fresh and processed outlets and intermediate and long-term information on supply and demand prospects.

A comprehensive analysis is needed which will identify and measure the importance of the shifts in geographical location and concentration of vegetable production during recent years, as well as the shift from fresh to processed foods, and of the factors affecting supply and prices of vegetables.

Consumer Preference for Citrus Fruits and Vegetables. Research to determine consumers' preferences, usages, and buying practices for selected citrus fruits and vegetables should be initiated in order to market these products most effectively. Information on consumer use and opinions about avocados should also be obtained.

Consumer Preference for Nursery and Floricultural Products. Marketing of cut flowers and potted plants through mass market outlets is having a tremendous impact on market structure and marketing practices for these products. Information is urgently needed concerning household consumers' opinions of and preferences for cut flowers, potted plants, and landscaping materials, and the decision-making process involved in purchase or nonpurchase of the products. The effects of specific marketing techniques on consumer purchases of nursery and floricultural products should also be investigated.

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UNITED STATES DEPARTMENT OF AGRICULTURE,
Research Program Development and Evaluation Staff
Washington, D. C. 20250

Minutes of the Third Meeting of the
~~HORTICULTURAL CROPS RESEARCH ADVISORY COMMITTEE~~
Washington, D. C.,
February 14-18, 1966.

The third meeting of the Horticultural Crops Research Advisory Committee was held in Washington, D. C., February 14-18, 1966, with all members present except Dr. James R. Oyler. Mr. John T. Lesley, Florida Citrus Exchange, Tampa, Florida, represented the National Agricultural Research Advisory Committee at the meeting. Mr. Earl R. Glover, Acting Deputy Administrator for Marketing Research, Agricultural Research Service, served as Chairman for the meeting. Mr. W. C. Dachtler, Head, Advisory Committee Secretariat, Research Program and Development Staff, acted as Chairman when Mr. Glover was not able to be there.

The meeting was opened by Mr. Glover on February 14, 1966, at 9:30 a.m., in Room 218 Administration Building, with the introduction of the Committee members and Departmental representatives. Dr. George L. Mehren, Assistant Secretary, welcomed the Committee members and spoke briefly on recent changes affecting the Department's research program. He also presented the new members, Dr. Jackson and Mr. Wack, with Certificates of Appointment. Dr. E. C. Elting, Associate Director, Research Program Development and Evaluation Staff, reviewed administrative and budgetary developments since the last meeting of the Committee. He also reported progress on the "Long-Range Study of Agricultural Research" which the Department and the Association of State Universities and Land Grant Colleges are conducting on a cooperative basis.

The afternoon session was opened by Mr. Dachtler at 1:00 p.m. Committee members were given brief orientation concerning responsibilities and assignments on the various subcommittees. The membership assignments and the areas of review for each subcommittee were as follows:

Culture, Breeding and Genetics,
Disease and Variety Evaluation
Research

Harold S. Crawford
Hezekiah Jackson
John J. McCabe
Sidney W. Morrison
Frank Schuster

Insect, Weed, Nematode, Environ-
mental Pollution, and Agricultural
Engineering Research

Karl v. Christiernson
Samuel C. DeCou
Lewis M. Hardison
Walter Reuther

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Nutrition, Consumer and
Industrial Use Research

Eyvind M. Faye
J. R. Graves
Leon C. Jones
James R. Oyler

Marketing and Economic Research

Ralph W. Bachman
R. H. Cintron
William J. Morgan
Frank G. Wack

General Recommendations

Walter Reuther
John J. McCabe
Eyvind M. Faye
William J. Morgan

The remainder of the afternoon was devoted to a review and evaluation of the Department's research program. Dr. Willis Gortner discussed human nutrition research. Dr. Bernice Watts reported on consumer and food economics research. Dr. J. W. White reviewed the vegetable research program conducted by the Eastern Utilization Research and Development Division at Wyndmoor, Pennsylvania, and Dr. William L. Porter described research on potatoes by this division at the Red River Research Laboratory, East Grand Forks, North Dakota. Robert L. Olson reported on research at the Western Utilization Research and Development Division, Albany, California. Dr. M. K. Veldhuis discussed research at the Southern Utilization Research and Development Division, New Orleans, Louisiana. The meeting was recessed at 4:45 p.m.

The Committee, Departmental staff members, and guests assembled at the Flagship Restaurant at 6:00 p.m. for a social hour and dinner.

On Tuesday, February 15, 1966, the meeting was opened at 9:15 a.m. in room 3115, South Building. The morning was devoted to evaluation of research in the field of marketing and economics. Dr. J. K. Samuels discussed work in cooperative marketing. Lloyd Martin, Economic Research Service, introduced Dr. Kenneth Ogren who reviewed the research program conducted by the Economic Research Service. Added remarks were provided by Dr. Peter Henderson and Dr. Kermit Bird, Marketing Economics Division, ERS. Ben Pubols reviewed research on fruits and nuts and Donald S. Karyloski research on vegetables and potatoes being conducted by the Economic and Statistical Analysis Division, ERS. Margaret Weidenhamer reported on consumer preference research conducted by the Statistical Reporting Service. Dr. W. T. Pentzer and Lloyd Ryall reported on research by the Market Quality Research Division of the Agricultural Research Service. Gerald Kline, Dean Winters, and Dr. John E. Clayton reported on research being conducted by the Transportation and Facilities Research Division.

The afternoon session continued with Dr. Clayton's report at 1:05 p.m. Beginning at 1:25 p.m., the remainder of the afternoon was spent in review and evaluation of research in the Crops Research and Agricultural Engineering Research Divisions. Dr. R. E. Webb reviewed the vegetable program, and Dr. Robert Ackley the potato-sweetpotato program.

Dr. L. C. Cochran, Dr. D. H. Scott, and Dr. Harold W. Fogle reviewed the research programs in crops research on fruits and nuts. Dr. Neil Stuart and Dr. Robert Stewart described research on ornamentals. Crops protection research was covered by Dr. William B. Ennis and Dr. L. L. Danielson. Agricultural engineering research was reviewed by Dr. L. H. Liljedahl and by Dr. Jordan Levin.

On Wednesday, February 16, 1966, the meeting reconvened at 9:00 a.m. in Room 3115 South Building with Dr. E. F. Knipling broadly summarizing research of the Entomology Research Division. Dr. L. D. Christenson and Dr. Edgar Taylor provided a more detailed review of the entomological research program.

At 10:30, the Committee boarded a bus for the Agricultural Research Center at Beltsville, Maryland, where they made a tour through the Entomology and Crops Research Division Laboratories. Dr. A. M. Keimpel, Dr. W. E. Robbins, Dr. R. N. Stewart, Dr. Neil W. Stuart, Dr. D. H. Scott, Dr. H. W. Fogle, Dr. H. J. Brooks, Dr. R. V. Ackley, Dr. J. R. McGrew, Dr. R. H. Converse, Dr. R. E. Webb, and Dr. L. C. Cochran provided the exhibits and discussed their research. The group returned to Washington, D. C., at 5:00 p.m.

On Thursday, February 17, 1966, the meeting commenced at 9:10 a.m. in Room 3115 South Building, with a general discussion on various subjects of especial concern to the Committee. The Committee then broke up into subcommittees to draft recommendations for review by the entire Committee.

On Friday, February 18, the meeting opened at 9:20 a.m. in Room 3115 South Agriculture Building to review subcommittee drafts and develop the Committee's Report and Recommendations to the Secretary. The Committee's comments and recommendations are formalized in the attached report which is made a part of these Minutes.

An invitation to meet in the Weslaco, Texas, area was extended to the Committee by Mr. Frank Schuster. The Committee recommended that its next meeting be held in the field and, if possible, in the vicinity of Weslaco and MacAllen, Texas, where a number of research projects are being carried on which are of interest to the group. It was suggested that the meeting be scheduled during the first week of February 1967 to avoid conflicts. The Committee expressed its appreciation to the USDA personnel for their excellent reporting, and to all others who helped make the meeting a success. Mr. DeCou requested that a list of the staff members' names and addresses be mailed to the Committee.

The meeting adjourned at 12:30 p.m.



Axel L. Andersen, Executive Secretary

Attachment:
Committee Report and Recommendations

